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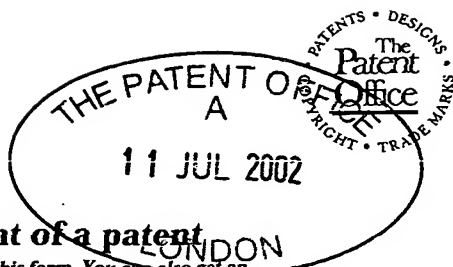
I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

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Signed   
Dated 16 June 2003



12JUL02 E732727-1 D02246  
P01/7700-0.00-0216115.6

# Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road  
Newport  
South Wales  
NP10 8QQ

1. Your reference

P014708GB AP FAG

2. Patent application number

(The Patent Office will fill in this part)

0216115.6

3. Full name, address and postcode of the or of each applicant (underline all surnames)

PARKER HANNIFIN (UK) LIMITED  
Parker House, 55 Maylands Avenue  
Hemel Hempstead, Herts  
HP2 4SJ

Patents ADP number (if you know it)

7525207002

If the applicant is a corporate body, give the country/state of its incorporation

UK

4. Title of the invention

"Self-Venting Solenoid Drain Valves"

5. Name of your agent (if you have one)

D Young & Co

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

21 New Fetter Lane  
London  
EC4A 1DA

Patents ADP number (if you know it)

59006

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

Yes

- a) any applicant named in part 3 is not an inventor, or
  - b) there is an inventor who is not named as an applicant, or
  - c) any named applicant is a corporate body.
- See note (d))

## SELF-VENTING SOLENOID DRAIN VALVES

This invention relates to self-venting solenoid drain valves, such as may be used in automotive fuel systems, typically for releasing water and contaminants from such fuel systems.

A solenoid drain system has previously been developed for releasing water and contaminants from fuel systems, drains being provided in the water and fuel bowl in a typical water separator and fuel filter.

Previously, the operator would have to do daily checks on the fuel filter of, for example, a diesel-powered commercial vehicle, and release any water separated out of the fuel by using a manual drain. However, with a solenoid drain, the operation can be electronically controlled and be a part of an engine management system.

The fuel filter is part of a closed system. For water to be released from the bowl when the solenoid drain is energised, there has to be either pressurisation of the fuel filter or the filter has to be mounted below the fuel tank so as to create a pressure head. This is not practical in many applications.

Using the previously-proposed solenoid drain, air cannot get into the system.

According to the present invention, a self-venting drain valve is proposed in which suitably arranged air venting allows fluid to leave the bowl without the need to pressurise the system. Hence, it is not necessary to provide a pump or to mount the assembly lower than the fuel tank.

In one embodiment of the invention, shown in Figure 1 of the drawings, the self-venting drain comprises three components, namely a solenoid adapter, a piston and a solenoid.

The solenoid may be an off-the-shelf product supplied by any manufacturer.

The solenoid adapter screws into the bowl but also has two connecting screws fasten the solenoid to it. This constitutes the main part of the system.

The piston is a modified version of the previously-developed solenoid drain assembly. It is required to create a seal and slides within the solenoid body.

Figure 2 shows the assembled self-venting drain, Figure 3 shows the piston inside the solenoid and Figures 4A and 4B show the solenoid adapter.

As shown in Figure 2, the assembled self-venting drain includes connections to a dc supply voltage. With no voltage across the solenoid coil, the piston as shown in Figure 3 will be raised. The spring around it will be in partial compression in the installed position. In this position, the piston will seal against the solenoid adapter  
5 allowing nothing in or out of the water and fuel bowl of the fuel filter.

The solenoid adapter shown in Figures 4A and 4B comprises an air inlet which leads into the air tube, and a drain tube. The piston seals the drain tube and the air tube.

When there is an applied voltage to the solenoid coil, a magnetic field is  
10 created and the piston is drawn into the solenoid body further compressing the spring and the piston seal is broken with the air and drain tubes.

Air is then drawn through the inlet up into the air tube and into the filter housing. This breaks the air lock allowing fluid to leave the water and fuel bowl into the body of the solenoid and out of the bottom barb.

15 The reason that air can enter into the system and the air lock is overcome is because of the positioning of the air inlet in relation to the drain tube. The air inlet is positioned higher than the lowest point of the drain tube. The difference in height creates a pressure head thus allowing air to enter the air tube and fluid then to drain.

When the voltage across the coil is switched off, the magnetic field is removed.  
20 The piston then returns to recreate a seal with the air and drain tubes forcing it to move back towards the solenoid adapter passing over the air inlet. This stops the airflow into the air tube and then the piston seals against the drain and the air tubes. This stops all fluid movement and the self-venting drain is closed.

Figures 5 and 6 show a modified version of the self-venting drain which  
25 operates in a similar manner to that previously described. Figure 5 shows the device in the closed condition, in which the piston seals both the drain and air passages, whereas Figure 6 shows the device in the open condition with both the drain and air passages open for air to enter via the air vent port and consequently fluid to drain through the water drain port and out through the water drain.

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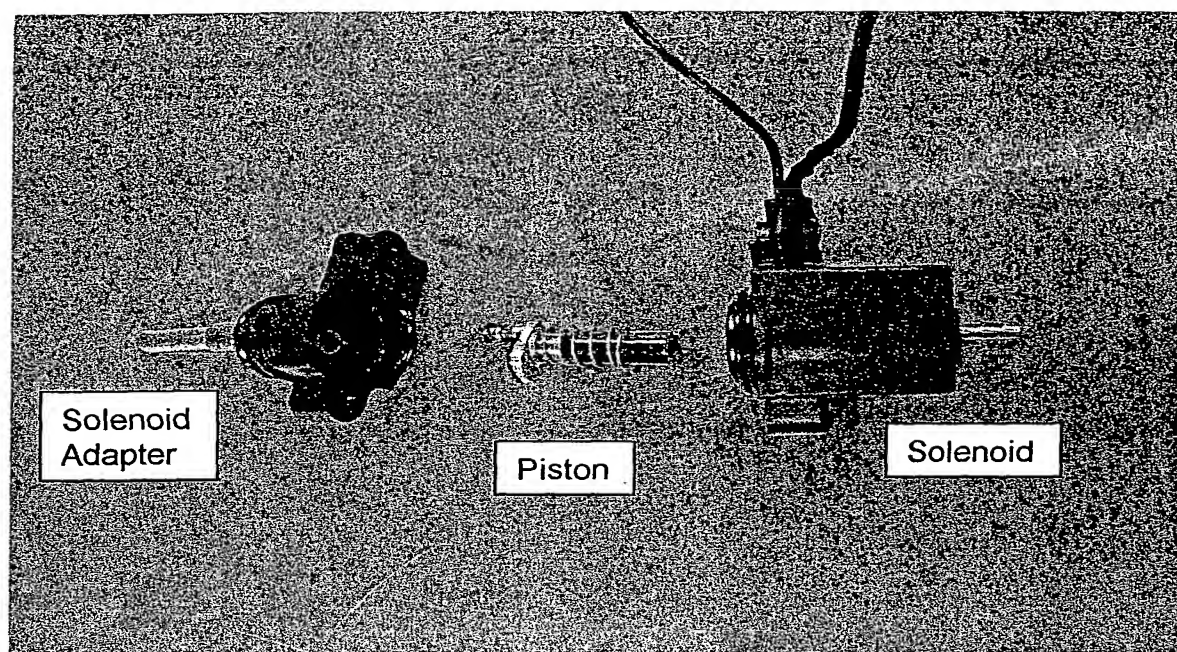


FIG. 1

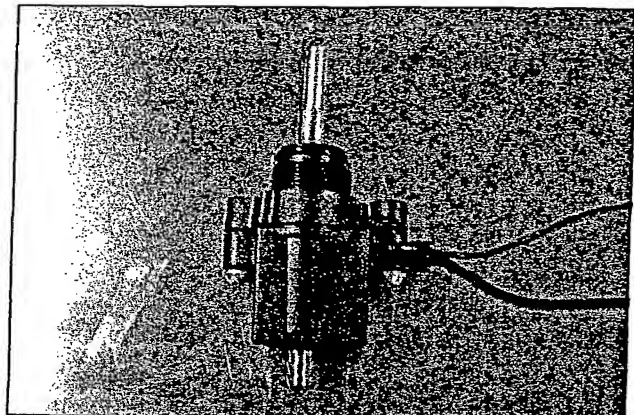


FIG. 2

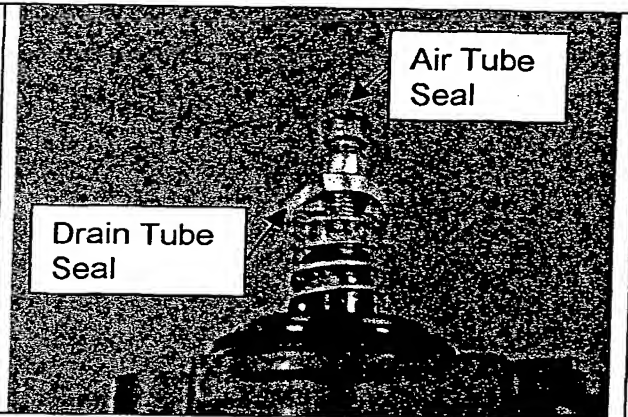


FIG. 3

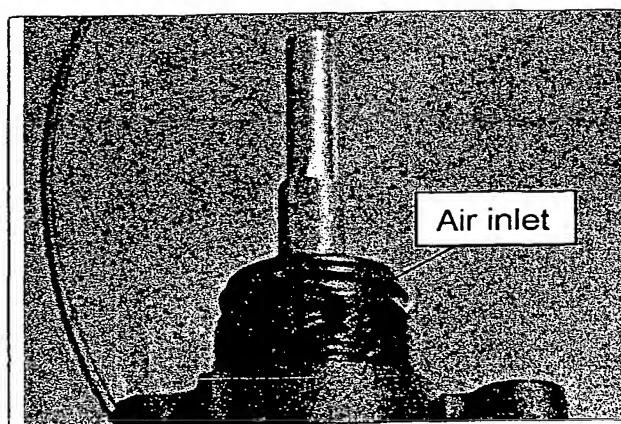


FIG. 4A

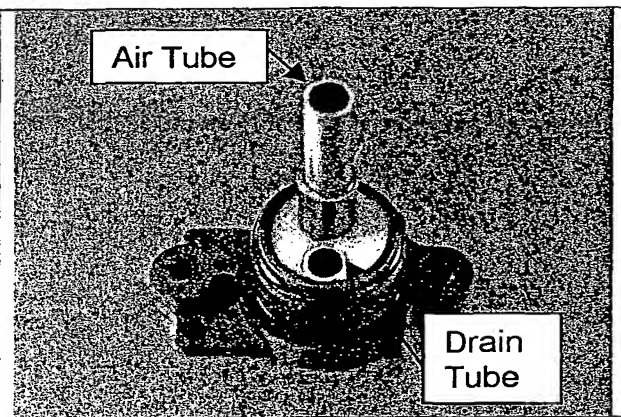


FIG. 4B

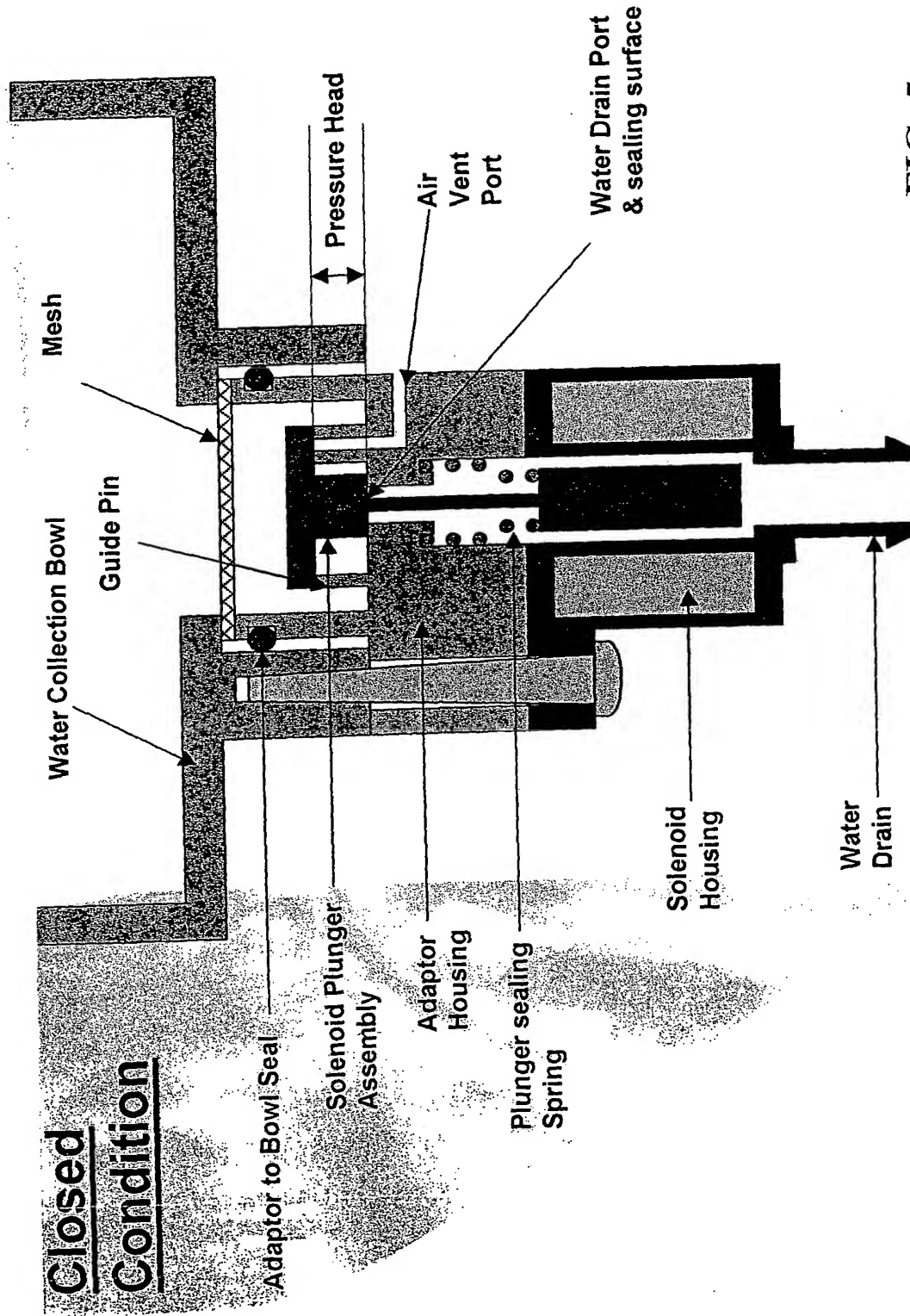


FIG. 5

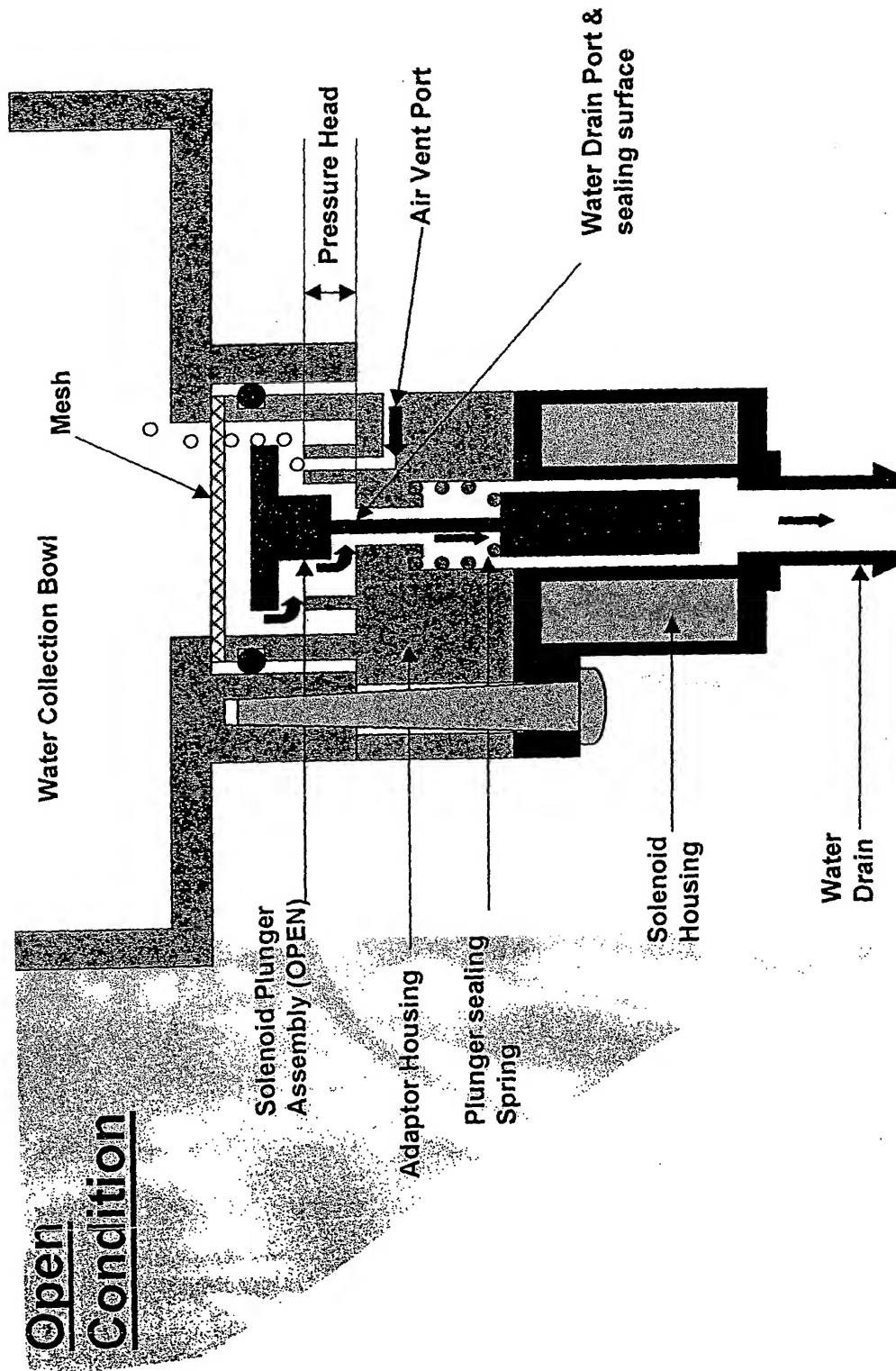


FIG. 6